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ANALYSIS OF X-RAY ECLIPSES IN SS433

Detailed X-ray light curves of SS433 (=V1343 Aql) within primary eclipse for the phases Ψ =0.11, 0.33 and 0.5 of the precessional period $162^{d}.5$ have been obtained recently (Brinkmann et al.; 1989, Kawai, 1989). Precessional phase Ψ =0 corresponds to the moment of maximum separation of the moving emissions.

Following to the results of the interpretation of the optical light curves of SS433 (Antokhina and Cherepashchuk, 1987) we try to do an analysis of these X-ray eclipsing light curves of SS433 in the framework of the Roche model of close binary system with the precessing thick accretion disk containing geometrically thick electron scattering hot nonrelativistic "jets" in its central parts. Physical grounds for the existence of such a thick nonrelativistic "jets" in SS433 have been presented by Kawai (1989). It has been supposed that the shape of X-ray eclipsing light curves is due to the eclipse of this thick nonrelativistic X-ray "jets" by the external parts of the accretion disk and by the normal star. Thin relativistic X-ray jets going out from the tops of the thick nonrelativistic "jets" are almost noneclipsing by the normal star and contribute the third noneclipsing light in the binary system. External parts of the accretion disk are described by the spheroid with the ratio of the semiaxes ("thickness") k=b/a (b and a are the semiaxes of this spheroid). The thin relativistic jets must be rather short because they have to be eclipsed by the external parts of the accretion disk (red moving FeXXV line is not observed in the X-ray spectrum of SS433). On the other hand, the thin jets have to be rather long because they are almost noneclipsed by the normal star. It helps us to constrain the "thickness" of accretion disk k=b/a $\approx$0.7. Internal parts of the disk are conic.

The basic parameters in our model are as follows: the mass ratio for the relativistic component and for normal star $q=M_x/M_v$, the "thickness" of the accretion disk k=b/a, semiaxes of the thick nonrelativistic "jets" a_j, b_j, the angle of the cone ω describing interior parts of the disk. The filling factor μ for the normal star in its Roche lobe is supposed to be 1. Our detailed calculations show that the value of μ less than 1 is in contradic-

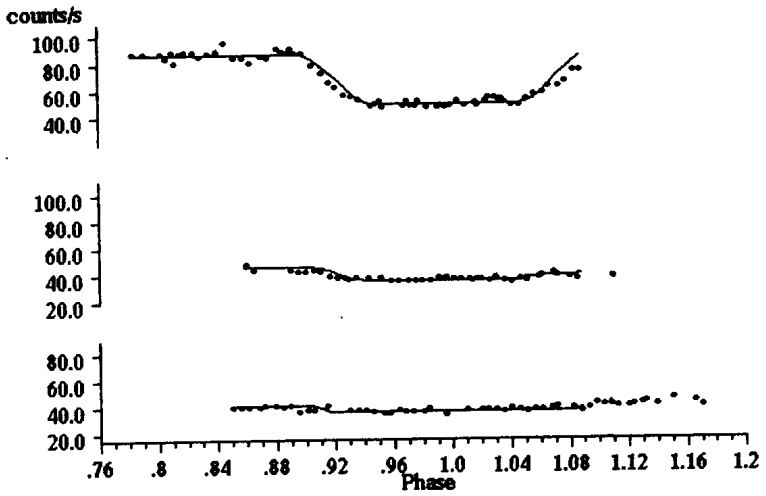

Figure 1. Observed (point) and theoretical (lines) X-ray light curves at different phases of the 162.5-day precessional period Ψ = 0.11 (top), 0.33 (centre), 0.5 (bottom).

tion with X-ray observations. The value of the semiaxis of the spheroid a for the external parts of the disk is equal to the distance between the centrum of the accretion disk and the inner Lagrangian point.

The synthesized X-ray eclipsing light curves for three phases of precessional period, Ψ =0.11, 0.33, 0.5 have been compared with observational light curves and values of the parameters q, k, a_j, b_j and ω have been determined. The shape of eclipsing X-ray light curve may be well described by the thick and thin disk, but thick disk is more preferable from the point of view described above. The obtained confidence interval for q is $0.15 \leq q \leq 0.25$.

The best solution was obtained for the values of q=0.2, k=0.7, a_j=0.1, b_j=0.2, $\omega = 60^{\circ}$ (see Fig. 1). The computer simulated pictures corresponding to this model are presented in Fig. 2. For the phase Ψ =0.5 there is no satisfactory agreement between the observations if $\omega = 60^{\circ}$. But for $\omega = 40^{\circ}$ we obtained a good agreement with observations (see Fig. 1). This fact can be understood taking into account the probable complicated shape of the disk.

For q=0.2 and mass function $f(M)=10\ M_{\odot}$ (Crampton and Hutchings, 1981) the value of mass of the relativistic objects is $M_x=3.1\ M_{\odot}$. The upper limits for for q and M_x $q \leq 0.25$, $M_x \leq 4\ M_{\odot}$ obtained from analysis of X-ray eclipses are close to the lower limits for q and M_x determined by Antokhina and Cherepashchuk (1987) from the analysis of the optical light curves of SS433:

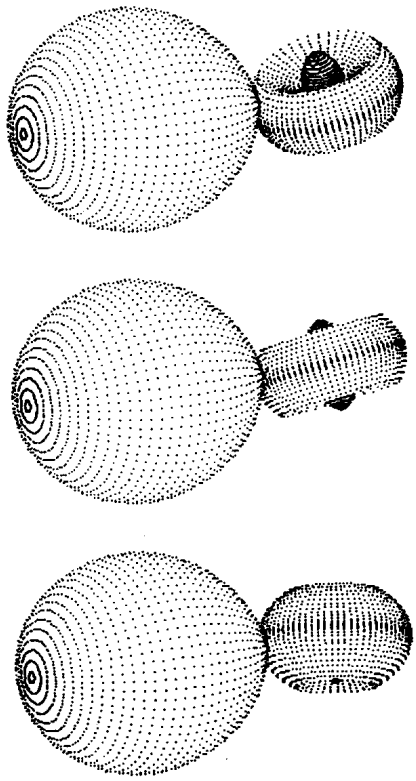

Figure 2. Computer simulated picture of X-ray eclipses in the SS433 system for three precessional phases ψ = 0.11 (top), 0.33 (centre), 0.5 (bottom).

$q > 0.25$, $M_x > 4\ M_\bullet$. It should be noted that because the normal star overfills its Roche lobe, and the dimension of the Roche lobe is less than the level of normal star photosphere, the upper limit for q obtained from X-ray eclipses may be increased up to q=0.3.

It should be also noted that the value of q=0.2-0.3 corresponds to the total eclipse of the accretion disk by the normal star which is in conflict with the optical light curves of SS433. This problem needs further investigations.

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